Can the past inform the future of science in primary schools?

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This article reports the main findings from a Review commissioned by the Wellcome Trust into science in primary schools. On the basis of those findings, it is argued that the current approach to primary science and the drive to raise standards in literacy and numeracy are turning pupils off science in primary schools, the fallout of which can be seen in secondary, further and higher education.

Attainment in science

One would imagine that the position of science as a core subject would lead to an increase in attainment. Statutory test results from the End of Key Stage 2 (age 11) did indeed show a steep rise from 1995 to 2000, when it reached a plateau and has since remained stable (See Figure 1).

Up until the year 2000, government sources were keen to cite that increase as real improvement in standards in primary schools, but the reliability of such figures has been called into question by Tymms and Fitz-Gibbon (2001), whose challenges were subsequently upheld by the Statistics Commission (2005). A much more modest increase in standards in science is further supported by statistics from other independent sources. For instance, the Performance Indictors in Primary Schools (PIPS) Project, which is run by the Centre for Evaluation and Monitoring (CEM) at Durham University, showed only a modest increase. An analysis of PIPS Year 6 (age 11) science data from the same 54 schools between 1999 and 2007 showed that average raw scores rose by a relatively small amount (Massey, 2003).

The format of the statutory End of Key Stage 2 science assessments means that they are limited in their scope to probe children's real understanding of scientific concepts. We believe they simply measure a pupil's capacity to learn a body of facts, and their 'high stakes' nature constrains children's science learning because schools are under such pressure to meet targets. Research by Collins *et al* (2008) suggests that the recent abolition of testing in science at Key Stage 2 in Wales is having a beneficial effect on the development of pupils' knowledge and understanding of science.

Attitudes to school science

It is well established that young people's attitudes to school become less positive in the late primary phase and continue to decline as they progress through secondary school. This trend was also seen in attitudes to school science. International comparative surveys have reported a decline in primary school pupils' enjoyment of science between the years of 1995 and 2003. These trends are not confined to the UK, but English pupils' attitudes towards science are less positive than those of other nations.

Historically, many primary teachers have expressed a lack of confidence towards the teaching of science. In the 1970s, primary teachers' science subject knowledge was identified as the major obstacle to good quality science provision in primary schools and similar concerns were expressed in the 1990s. Although research suggests that confidence to teach science has started to improve, a UK-wide survey of primary teachers in 2005 found that half still cited lack of confidence and ability to teach science as the issue of major concern in primary science. Evidence suggests that what seems to increase primary teachers' confidence in their own ability to teach science is good quality in-service training.

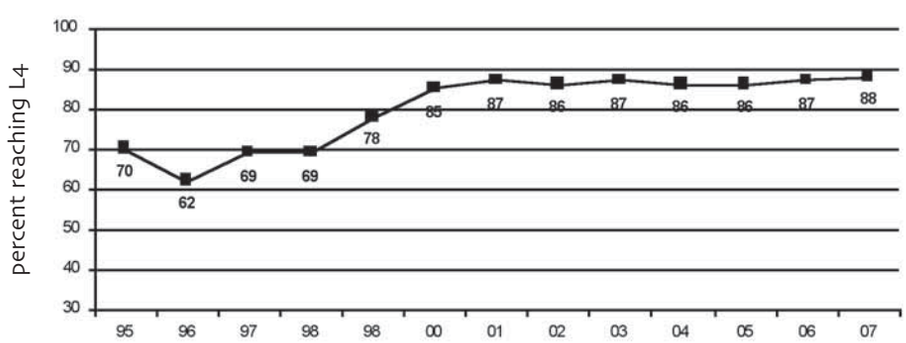
Science as a 'core'?

The amount of science taught in primary schools has increased over time, jumping abruptly in 1989 when the 1988 Education Act came into effect and made science a 'core' subject in the statutory curriculum in state schools. In 2003, the Department for Education and Skills published its primary national strategy and set out as one of its priority targets *'to extend the sort of support provided by the literacy and numeracy strategies to all the Foundation subjects'*. Despite this rhetoric, there is increasing evidence to suggest that science is being undermined as a 'core' primary subject and the time allocated to its teaching is in decline. In the drive to raise standards, mathematics and English dominate the primary curriculum. We wait to see what impact the recent Rose review will have on the implementation of science in the primary curriculum.

The fallout beyond primary school

The fallout from the recent approach to science education in primary schools has been felt in secondary schools and beyond as the 'swing away from science'. The number of young people opting to take science subjects in

Figure 1



secondary and further education has declined. For instance, Figure 2 shows the numbers of students between 16 and 18 years of age in schools and further education opting to take A-levels in physics, chemistry, biology, and psychology between 1996 and 2007.

Until quite recently the proportion of pupils taking A-level examinations in science had been in decline. The numbers sitting physics A-levels show a year-on-year decline since 1998 (although numbers seem to have stabilised in 2007). This decline was set against the background of a generally increasing trend in the proportion of students gaining two or more A-level passes. However, it should be noted that any interpretation of trends in A-level attainment is complicated by the introduction of *Curriculum 2000* reform. This led to the modularisation of A-level courses and subsequently a greater number of pupils taking A-level examinations. The decline in the proportion and, for physics, the absolute number of students has been recognised as a major threat to the future economic prosperity of the UK. The trend does not seem to be confined to the UK alone, but represents at least a pan-European phenomenon.

Conclusions

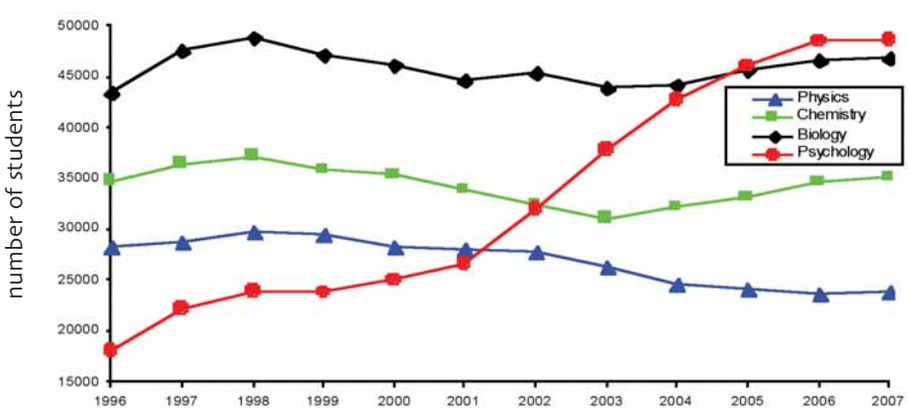
Our interpretations of the findings of the Review lead us to argue that the current approach to primary science in schools is not fostering scientific thought and curiosity to the extent that may be possible. The major problem lies in the way in which the results of the current assessment procedures in schools in England are used. Published in the performance league tables in the national media, the results of SATs tests are used to hold teachers and schools accountable. This must encourage narrow approaches, even if the tests themselves are designed to encourage clear thinking. They pressurise teachers to 'teach to the test' rather than encourage them to teach for conceptual understanding. We therefore think that there is an argument for a careful reconsideration of the current approach to the teaching and assessment of science in English primary schools.

We recommend a four-stage strategy:

- Firstly, we need a national debate about the purpose of science in primary schools. We suggest that the purpose of science in primary school should be to foster a sense of curiosity and positive attitudes in the young child. Do others agree?
- Secondly, establish the evidence base. We recommend a systematic review of well-evaluated approaches to primary science education from across the world.
- Thirdly, develop new approaches and trial them. It is unlikely that the evidence base will lead to a well-defined way forward. Consequently, we recommend that there be a call for proposals for the development of a primary science curriculum and that a small number are funded as trials.
- Lastly, we recommend that the efficacy of new and existing programmes should undergo scientific evaluation involving randomised controlled trials.

The full Review, which was commissioned by the Wellcome Trust as part of *Perspectives on Education*, their new series of reports on UK science education, can be downloaded from: http://www.wellcome.ac.uk/Aboutus/Publications/Books/Education/Perspectives/index.htm

Figure 2



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